

EXTRACTION OF RIVER NETWORKS  
FROM DIGITAL ELEVATION MODEL FOR  
THE ROMPIN RIVER BASIN

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## **SUPERVISOR'S DECLARATION**

I hereby declare that I have checked this thesis and in my opinion, this thesis is adequate in terms of scope and quality for the award of the Bachelor Degree of Civil Engineering

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## **STUDENT'S DECLARATION**

I hereby declare that the work in this thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at Universiti Malaysia Pahang or any other institutions.

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## **ABSTRAK**

Pemetaan dan visualisasi topografi telah menjadi lebih mudah kerana kemajuan teknologi dalam sistem informasi geografi (GIS). Peningkatan kemajuan dalam teknologi pemetaan melalui pertambahan ketersediaan Model Elevasi Digital (DEM) yang juga dikenali sebagai penyedia data spatial digital. Ciri-ciri hidrologi yang diekstrak daripada DEM adalah tepat dan ianya boleh dilakukan dengan lebih cepat berbanding kaedah tradisional. Tujuan kajian ini adalah untuk menggambarkan jaringan sungai dan mengekstrak ciri-ciri hidrologi daripada DEM bagi Sungai Rompin. Shuttle Radar Topografi Misi DEM (Data Elevasi SRTM 1 Arc-Global) dengan resolusi 30 m digunakan sebagai DEM untuk kajian ini. Pengekstrakan ciri-ciri fizikal yang diperlukan telah dilakukan dengan menggunakan aplikasi bersepadu ArcGIS-HEC-GeoHMS. Validasi jaringan sungai simulasi dibuat dengan membandingkan dengan ianya bersama jaringan sungai digital daripada Google Earth. Berdasarkan hasil validasi dapat disimpulkan bahawa DEM 30 m adalah mencukupi untuk menggambarkan dan menganggarkan jaringan sungai dan ciri-ciri fizikal Sungai Rompin dengan ketepatan yang dapat diterima.

## **ABSTRACT**

Mapping and topography visualization of an area of interest has become more convenient due to the advancement of technology in the geographical information system (GIS). The advancement in the mapping technology is enhanced by the increasing availability of the Digital Elevation Model (DEM) also known as the digital spatial data provider. The hydrological features of a basin extracted from the DEM is precise and can be done faster compared to the traditional method. The purpose of this study are to delineate the river network and extract the physical hydrological characteristics from DEM dataset for the Rompin River Basin. Shuttle Radar Topography Mission digital elevation model (SRTM 1 Arc-Second Global Elevation Data) with 30 m resolution was used as the DEM for this study. The extraction of the physical characteristics required was performed by using ArcGIS application integrated with HEC-GeoHMS extension. For the validation of the simulated river network, the results obtained were compared with the digitized river network from Google Earth. Based on the validation outcome, it is concluded that DEM of 30 m is sufficient to delineate and estimate the river network and physical characteristics of the Rompin River Basin with acceptable precision.

## **TABLE OF CONTENT**

**DECLARATION**

**TITLE PAGE**

**ACKNOWLEDGEMENTS** **ii**

**ABSTRAK** **iii**

**ABSTRACT** **iv**

**TABLE OF CONTENT** **v**

**LIST OF TABLES** **viii**

**LIST OF FIGURES** **ix**

**LIST OF SYMBOLS** **x**

**LIST OF ABBREVIATIONS** **xi**

**CHAPTER 1 INTRODUCTION** **1**

1.1 Background 1

1.2 Problem Statement 2

1.3 Objectives 3

1.4 Scope and Limitation of Study 3

1.5 Significance of Study 4

**CHAPTER 2 LITERATURE REVIEW** **6**

2.1 Watershed 6

2.1.1 Physical Characteristics of the Watershed 8

2.1.2 Watershed Delineation 10

2.2 Digital Elevation Model (DEM) 14



2.2.1	Applications of DEM in Hydrology	15
2.2.2	Limitations of DEM in Low Terrain	16
2.3	SRTM Data	17
2.4	Geographical Information System	19
2.4.1	Data Representation in GIS	20
2.4.2	GIS in Hydrology and Water Resource Management	21
2.5	Previous Case Studies	22
<b>CHAPTER 3 METHODOLOGY</b>		<b>24</b>
3.1	Introduction	24
3.2	Flow Chart of Methodology	25
3.3	Study Area	26
3.4	Data Collection	27
3.5	Data Pre-processing	28
3.6	Watershed and River Network Delineation	29
3.7	Extraction of Physical Characteristics	31
3.8	Hydrologic Parameters and HEC-HMS Modelling Development	33
3.9	Rainfall Distribution in RRB	34
3.10	Model Performance Analysis	34
<b>CHAPTER 4 RESULTS AND DISCUSSION</b>		<b>35</b>
4.1	Watershed Delineation	35
4.2	Distribution of Sub-basins	36
4.3	Spatial Distribution of Elevation and Slope	39
4.4	Delineated Longest Flow Path	41
4.5	Delineated Centroids and Centroidal Longest Flow Path	43

4.6	Input Files for HEC-HMS	46
4.7	Determination of Gauge Weights	47
4.8	Threshold Simulations	50
4.9	Validation of River Network	53
4.10	Summary	55
<b>CHAPTER 5 CONCLUSION</b>		<b>56</b>
5.1	Introduction	56
5.2	Conclusion	56
5.3	Recommendation	57
<b>REFERENCES</b>		<b>59</b>
<b>APPENDIX A HEC-HMS MODEL DEVELOPMENT</b>		<b>64</b>

## **LIST OF TABLES**

Table 2.1	Classification of watershed size	8
Table 2.2	SRTM Specification	18
Table 3.1	Description of SRTM data	27
Table 3.2	Rainfall stations in the Rompin River Basin	28
Table 3.3	Physical Characteristics of streams and sub-basins	32
Table 4.1	General characteristics of the SRTM based watershed	36
Table 4.2	Result of the basic parameters for the Rompin River Basin	38
Table 4.3	Spatial distribution of basin and river slopes	40
Table 4.4	Result of the longest flow path delineation	42
Table 4.5	Result of the centroid elevations and the centroidal flow path	45
Table 4.6	Gauge weights and weighted percentage of each sub-basin	48
Table 4.7	Summary of the simulated stream networks and watershed	53
Table 4.8	Coordinates distance between the points	54

## LIST OF FIGURES

Figure 1.1	The satellite map of Rompin River	4
Figure 2.1	Watershed diagram	7
Figure 2.2	Type of watershed shape	9
Figure 2.3	Watershed delineation	10
Figure 2.4	Manual watershed delineation	11
Figure 2.5	Watershed components	13
Figure 2.6	Digital Elevation Model (DEM)	15
Figure 2.7	Comparison between SRTM 90 m and 30 m pixels	19
Figure 2.8	Watershed diagram	21
Figure 3.1	Flow chart of methodology	25
Figure 3.2	The Rompin River Basin	26
Figure 3.3	DEM map	27
Figure 3.4	Google Earth satellite image and traced streamline	28
Figure 3.5	Projected SRTM DEM and river network in Google Earth	29
Figure 3.6	Procedures of watershed and river network delineation	30
Figure 3.7	Depressions in raw DEM	31
Figure 3.8	Procedures of the physical characteristics extraction	32
Figure 3.9	Procedures of the hydrologic parameterization (left) and HMS model development (right)	33
Figure 4.1	Delineated watershed map	36
Figure 4.2	Demarcations of sub-basin boundaries	37
Figure 4.3	Spatial distribution of elevations	40
Figure 4.4	Longest flow path map	42
Figure 4.5	Centroid locations of each sub-basin	44
Figure 4.6	Centroidal longest flow path map	45
Figure 4.7	Schematic diagram for the setup of HEC-HMS	47
Figure 4.8	Thiessen polysons map	48
Figure 4.9	Comparison of the watershed delineation in three simulations	51
Figure 4.10	Simulated stream networks under different stream threshold values	52
Figure 4.11	Simulated and digitized river networks	53
Figure 4.12	Points marked on both digitized and simulated river networks	54

## LIST OF SYMBOLS

$O_i$	Observed coordinate (meter)
$S_i$	Simulated coordinate (meter)
$n$	Number of points

## **LIST OF ABBREVIATIONS**

ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
DEM	Digital Elevation Model
DID	Department of Irrigation and Drainage
DSM	Digital Surface Model
DTA	Digital Terrain Analysis
DTM	Digital Terrain Model
GDEM	Global Digital Elevation Map
GIS	Geographic Information System
GRASS	Geographic Resources Analysis Support System
HMS	Hydrologic Modelling System
IFSAR	Interferometric Synthetic Aperture Radar
ILWIS	Integrated Land and Water Information System
JPL	Jet Propulsion Laboratory
LIDAR	Light Detection and Ranging
NASA	National Aeronautics and Space Administration
NED	National Elevation Dataset
NGA	National Geospatial-Intelligence Agency
RMSE	Root Mean Square Error
RRB	Rompin River Basin
SRTM	Shuttle Radar Topography Mission
USGS	United States Geological Survey

## **CHAPTER 1**

### **INTRODUCTION**

#### **1.1 Background**

Malaysia is fortunate since it is free from natural disasters such as earthquake, volcano, and typhoon. The most devastating problems faced in this country are only flood and drought. Historically, Pahang is one of the state in Malaysia that has serious problems related to flooding as in many places in the world including the study area in this research, the Rompin River Basin. The Rompin River Basin experiences tropical climate all year-round which consists of wet and dry season. In December 2013, there were massive flash flood in the Rompin District. A total of 3,615 flood victims from 958 families were placed in 10 flood relief centres (Bernama, 2013). Some homes and roads were inundated and closed down in the area. Despite flood disaster, prolong drought was also affecting the area attributed to the El Nino phenomenon, which lasted between 6 to 18 months. According to the Department of Irrigation and Drainage, the water levels in most rivers have dropped drastically, including Sungai Rompin. Therefore, there is a need to delineate the river basins in an integrated way for better water resources management.

With the advancement of technology in the recent years, researchers and water managers have migrated from adopting the traditional method to computerized technology in analysing and extracting topographical dataset (Balasubramani, Saravanabavan, and Kandasamy, 2012). The computerized tool that is widely used is the Geographic Information System (GIS). GIS tool is designed to store, edit, analyse, and visualizes the spatial or geographic information of an area from DEM datasets (Bharata, Darshan, Pavan, and Shanubhog, 2014). Today GIS has served as one of the most powerful technology in hydrology and water resources development. There are several open-source GIS software including ArcGIS, GRASS GIS, OpenJUMP GIS, QGIS and many more that are available for GIS-based watershed delineation. The best-

known amongst them is the ArcGIS Hydrology tools which are useful to describe the physical components of a surface by identifying sinks, calculating flow direction and accumulation, stream order, delineating watershed and creating stream network (Alqaysi and Almuslehi, 2016). One of the most important applications of GIS is the delineation of watershed.

The input satellite data used in GIS application is the Digital Elevation Model (DEM). DEM has become popular in the field of hydrology due to its simplicity such as data structure, storage, and calculation. This elevation model provides 3D representation of a terrain surface, which is widely utilized in hydrological analyses including watersheds delineation (Fattah and Yuce, 2015). The data of terrain is stored in a square of grid for elevation values and topographic information such as slope properties, flow direction, flow accumulation, stream network and watershed attributes can be extracted. The key advantages of DEM are its ability to provide more precise measurement and faster than traditional manual delineation method (Mondal and Gupta, 2015).

In this study, ArcGIS is used to extract the river network and physical characteristics. For the validation of the simulated river network, the result obtained will be compared with the digitized river network from Google Earth. Meanwhile, for the physical characteristics, the validation is done by comparing the estimated result with the manual calculation. Finally, the results obtained from the delineated river network can be used as the topographic and hydrologic input for the hydrological study in water resource management work.

## **1.2 Problem Statement**

Since decades, flood and drought generally have become the most significant natural disasters in Malaysia, especially the east coast of Peninsula. The Rompin River Basin which is one of the district on the east coast has high potential to be affected by massive flood and drought. In flood and water resources study, topography information is important to identify the low-lying land and high land. Flood risk is generally higher at the low lying residential areas and agriculture lands. Moreover, these lands are also the highly populated areas in which leading to high water supply demands.



For a long river such as the Rompin River, extracting river network and hydrological information can be tedious and time consuming if the traditional method is implemented. Hence, it is essential to utilize the computerized technology available to categorize the topography elevation and delineate the river network in the Rompin River Basin. Furthermore, the lack of hydrological information regarding the Rompin River Basin shall be tackled to ease future research and modelling process.

### **1.3 Objectives**

This study aims to:

- To delineate river networks and watershed for the Rompin River Basin.
- To extract the physical characteristics for developing hydrologic models.

### **1.4 Scope and Limitation of Study**

This study covers only the Rompin River Basin as shown in the Figure 1.1. For the river network result comparison, the river network was digitized by tracing the streamline in Google Earth Pro Application (version 7.3.0.3832). Meanwhile, for the delineated river network, watershed analyses were done via extracting topographic datasets from DEM by using ArcGIS Hydrology tools. Extraction of physical characteristics include topography slope, roughness, sub stream and others. The DEM used in this study is the Shuttle Radar Topography Mission digital elevation model (SRTM 1 Arc-Second Global Elevation Data) with 30 m. This DEM map was selected because it can be downloaded from the United States Geological Survey (USGS) Earth Explorer without charges. Furthermore, it is the highest free version of DEM available online.

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